

AX.25 Version 2
Multi-channel
TNC FIRMWARE

(version 0.5)

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This firmware supports the full AX.25 link layer protocol, version 2.0 as described in the ARRL specification dated October 1984, as well as the pre-existing version 1.x. This implementation supports multiple simultaneous link connections with either version protocol. This release has been assembled for a maximum of four simultaneous connections. Which protocol version is used to initiate a connection is controlled by a tnc command, but the version will be automatically changed, if necessary, to conform to the version of the tnc responding. (NOTE: The existing firmware supplied by TAPR for the TNC-1 will NOT disiepeat version 2 protocol.)

The firmware is contained in one 2764 EPROM, and is intended to be installed in a TAPR TNC-1 (or equivalent, such as the AEA PKT-1 or Heath HD-4040) in socket U12. This assumes that a 6264 RAM is already installed in socket U7, with an additional 6264 RAM optionally installed in socket U8 (recommended if multi-channel operation is intended). The tnc parallel port is not currently used.

When installing the EPROM in U12 the first time, it will be necessary to start the tnc with the PARAMETER SOURCE switch set to the PROM position. This will cause default parameters to be written into NOVRAM memory but not PERMed. The RS-232 port will be initialized to 300 baud with no handshaking. The tnc source call sign will be all blanks, and should be set with the 'I' command, as well as any other default parameters that might need changing, before issuing a 'PERM' command. At this point, the PARAMETER SOURCE switch may be set to NOVRAM for subsequent operation. If the terminal baud rate has been changed, the new value will take effect following a reset.

All information sent to the tnc is in the form of lines, terminated by a CARRIAGE RETURN character. BACKSPACE and DELETE may be used to remove single characters from the line. The entire line may be backspaced out by entering a CONTROL-U or CONTROL-X. Lines beginning with an ESCAPE character (echoed as '* ') are interpreted as commands. If a command is issued with no parameter, the current value of that commands parameter is displayed. Lines without a leading ESCAPE character are sent as data. Data sent to channel 0 or a non-zero channel number that is not currently connected, will be sent out unproto. Data lines may be up to 256 characters long, including the terminating

CARRIAGE RETURN character.

The firmware source is written in 6809 assembly language. Emphasis was placed on using a state table driven design, utilizing the state tables provided in the ARRL specification. The source was assembled using a 6809 cross assembler from 2500 AD Software running on a Z-80/8086 TurboDOS development system (CP/M compatible).

COMMAND SUMMARY

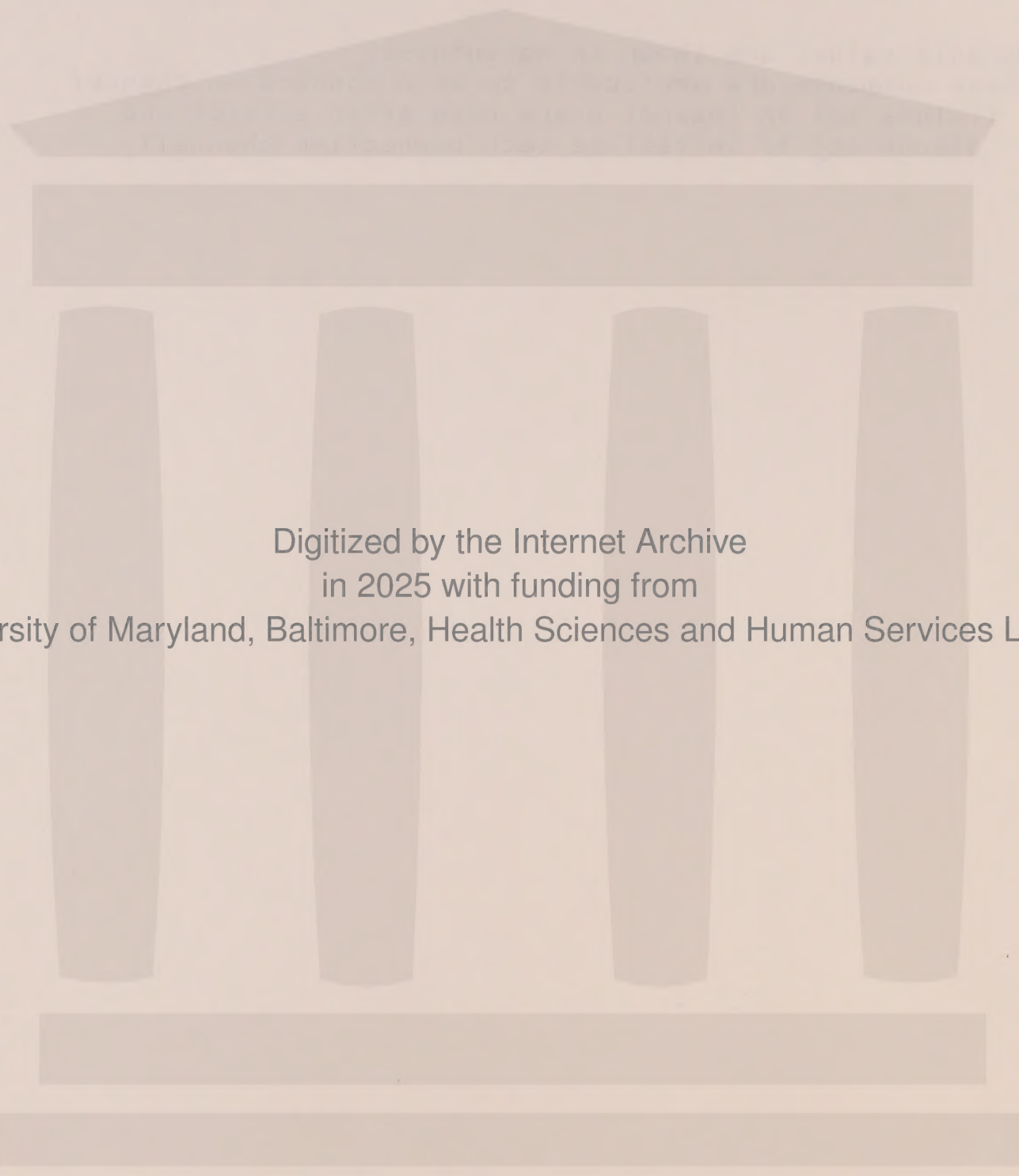
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COMMAND	PARAMETER	DESCRIPTION
A (1)	0 1	Auto linefeed disabled Auto linefeed enabled
B (6)	1-15	Terminal baud rate
* C	Cs1 [Cs2 ... Cs9]	Connect path (0=unproto path)
* D		Disconnect
E (1)	0 1	Echo command line disabled Echo command line enabled
* F (4)	1-15	Frame acknowledge (seconds)
H (1200)	50-4800	HDLC baud rate
I	Cs	I am (MYCALL)
K	1-4	Calibrate
L	[0-4]	Display link status
M (1)	0 1 2	Monitor always disabled Monitor enabled if disconnected Monitor always enabled
* N (10)	0-255	Number of tries (0=forever)
* O (4)	1-7	Number of outstanding I frames
PERM		Save parameters to NOVRAM
QRES		Re-start firmware
R (1)	0 1	Repeater disabled Repeater enabled
S (1)	0-4	Channel number (0=unproto)
T (4)	1-16	Transmitter delay (40ms)
U (1)	0 1	Flow control disabled Flow control enabled
* V (1)	1 2	Version 1 protocol initiated Version 2 protocol initiated

W (2)	0-15	Repeater wait (40ms)
X (1)	0	Transmitter PTT disabled
	1	Transmitter PTT enabled
Y (1)	0-4	Maximum connections

Default values are shown in parenthesis

- * These commands are applicable to each connection channel
(Values set on channel 0 are used after a reset and disconnect to initialize each connection channel).



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COMMAND DESCRIPTION

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The 'A' command is used to enable or disable the automatic insertion of LINEFEED characters after CARRIAGE RETURN characters to the terminal. This parameter is stored in NOVRAM.

The 'B' command is used to set the terminal baud rate, using one of the following parameters:

Parameter	Baud rate
1	50
2	75
3	110
4	135
5	150
6	300
7	600
8	1200
9	1800
10	2400
11	3600
12	4800
13	7200
14	9600
15	19200

After setting the baud rate with the 'B' command, the value must be PERMed, and will then take effect following a reset.

The 'C' command is used to initiate a link connection. Note that NO 'v' or 'via' is used between the destination call sign and the disipeater call signs. A 'C' command may be issued on a channel already in use to change the disipeater call signs, but not the destination call sign. A 'C' command issued when channel 0 is selected sets the unproto path.

The 'D' command is used to initiate a link disconnection. A 'D' command issued during the establishment or dis-establishment of a link will cause an immediate return to the disconnected state.

The 'E' command is used to enable or disable the echoing of input (commands and data) to the terminal. This parameter is stored in NOVRAM.

The 'F' command is used to set the frame acknowledgement interval. This interval is used to compute the timeout interval before a packet is retransmitted, using the formula:

$$\text{time (seconds)} = \text{frame ack} * (2 * \text{number of disipeaters} + 1)$$

A separate frame acknowledgement interval value is maintained for each connection channel. The value stored in channel 0 is used to initialize each connection channel after a reset or disconnection, and is the value that is stored in NOVRAM.

The 'H' command is used to set the HDLC baud rate. Non-standard values are rounded down to the next possible baud rate. In this case, use an 'H' command with no parameter to display the value actually set. This parameter is stored in NOVRAM. (A version of the firmware is available for use on tnc's running at the faster clock speed. HDLC rates up to 9600 baud are supported and command parameters do not require doubling.)

The 'I' command is used to set the tnc source call sign. The initial value is all blanks. After the source call sign has been entered, the 'PERM' command should be used to save it for use during subsequent operation.

The 'K' command is used to calibrate the tnc modem. The following parameters set the calibration modes listed:

Parameter	Calibration
1	Modem PLL
2	Low tone
3	High tone
4	Level/Null

This table may be displayed on the terminal by issuing a 'K' command with no parameter. The first three calibration modes will display the measured frequency on the terminal. When each mode is selected, jumpers settings are displayed as well as the appropriate adjustment point. The value shown in parenthesis is the normal setting for 1200 baud operation.

The 'L' command is used to display the link status of one or all channels. Information displayed includes the connection path, number of receive frames not yet displayed, number of send frames not yet transmitted, number of transmitted frames not yet acknowledged, and the current retry count. A '+' character preceeding the channel number indicates the currently selected channel.

The 'M' command is used to set the monitor mode. When channel 0 is selected, monitoring will be enabled if either mode 1 or 2 is set. This parameter is stored in NOVRAM. When monitoring is enabled, the control and protocol identifier fields are both displayed in hexadecimal. A brief listing of the common control field values is included at the end of this document. Currently, the pid field is always an F0, signifying that no layer 3 is implemented.

The 'N' command is used to set the maximum number of times a

frame will be transmitted without receiving an appropriate acknowledgement, before a link failure is assumed. A separate maximum number of tries value is maintained for each connection channel. The value stored in channel 0 is used to initialize each connection channel after a reset or disconnection, and is the value that is stored in NOVRAM.

The 'O' command is used to set the maximum number of unacknowledged I frames that may be outstanding at any one time. A separate maximum number of unacknowledged I frames value is maintained for each connection channel. The value stored in channel 0 is used to initialize each connection channel after a reset or disconnection, and is the value that is stored in NOVRAM.

The 'PERM' command is used to change the parameter values stored in NOVRAM to those that are currently set.

The 'QRES' command is used to restart the firmware as if a hardware reset had been issued.

The 'R' command is used to enable or disable the disapeating of frames. This parameter is stored in NOVRAM.

The 'S' command is used to select the current channel number. This parameter is stored in NOVRAM.

The 'T' command is used to set the transmitter keyup delay interval. The parameter is specified in 40ms increments. This parameter is stored in NOVRAM.

The 'U' command is used to enable or disable flow control to the terminal. If flow control is enabled, output to the terminal will be inhibited while entering commands or data. If flow control is disabled, output to the terminal will not be restricted. Flow control should be disabled during periods in which the tnc is operated without a terminal, to avoid suspending output which will consume buffers. This parameter is stored in NOVRAM.

The 'V' command is used to select whether version 1 or 2 protocol will be used to initiate a link connection. A separate protocol version number value is maintained for each connection channel. The value stored in channel 0 is used to initialize each connection channel after a reset or disconnection, and is the value that is stored in NOVRAM.

The 'W' command is used to set the disapeater wait interval. The parameter is specified in 40ms increments. This parameter is stored in NOVRAM.

The 'X' command is used to enable or disable the transmitter PTT control line. This parameter is stored in NOVRAM.

The 'Y' command is used to set the maximum number of connections that may established by incoming requests. This command has no effect on the operators ability to initiate outgoing connection requests. This parameter is stored in NOVRAM.

DEFAULT PARAMETERS

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In some instances, it may be desirable to have default parameters which differ from the standard values. To allow easy access, all default parameters have been placed at the beginning of the EPROM. The following listing defines the layout of this area:

TYPE	VALUE	DESCRIPTION
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BYTE	1BH	COMMAND CHARACTER
BYTE	' ,60H	SOURCE CALL SIGN (SEE NOTE 1)
WORD	000AH	HDLC BAUD RATE DIVISOR (SEE NOTE 2)
BYTE	06H	TERMINAL BAUD RATE
BYTE	01H	MAXIMUM CONNECTIONS
BYTE	01H	MONITOR MODE
BYTE	01H	REPEATER DISABLE/ENABLE
BYTE	02H	REPEATER WAIT (40ms)
BYTE	04H	TRANSMITTER DELAY (40ms)
BYTE	01H	FLOW CONTROL DISABLE/ENABLE
BYTE	01H	TRANSMITTER PTT DISABLE/ENABLE
BYTE	01H	CHANNEL NUMBER
BYTE	01H	AUTO LINEFEED DISABLE/ENABLE
BYTE	01H	ECHO COMMAND LINE DISABLE/ENABLE
BYTE	00H	VERSION 2 INITIATED DISABLE/ENABLE
BYTE	04H	MAXIMUM UNACKNOWLEDGED FRAMES
BYTE	0AH	MAXIMUM TRY COUNT
BYTE	04H	FRAME ACKNOWLEDGE INTERVAL
BYTE	'CQ ' ,60H	UNPROTO CALL SIGN

DISABLE = 00H / ENABLE = 01H

NOTE 1: The secondary station id must be shifted left one bit and or'ed with 60H.

NOTE 2: The HDLC baud rate divisor is computed using the formula:

$$\text{divisor} = (14400 / \text{baud rate}) - 2$$

The HDLC baud rate divisor is stored most significant byte first.

CONTROL FIELD VALUES

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VALUE	DESCRIPTION
x1	RR - Receive Ready
x5	RNR - Receive Not Ready
x9	REJ - Reject
03	UI - Unnumbered Information
0F	DM - Disconnected Mode
2F	SABM - Connect Request
43	DISC - Disconnect Request
63	UA - Unnumbered Acknowledge
87	FRMR - Frame Reject
Even	I - Information (x0,x2,x4,x6,x8,xA,xC,xE)

NOTE: In some instances, the above values may have 10H added to them, which is the poll/final bit set. For more information, see ARRL AX.25 Amateur Packet-Radio Link-Layer Protocol specification, Version 2.0, dated October 1984.

